**The Right Chemistry: Chlorine can save lives or take lives**

The year was 1774, the place Uppsala, Sweden. Pharmacist Carl Wilhelm Scheele had taken to dabbling in chemistry and had just poured some hydrochloric acid onto pyrolusite, a black mineral. He was taken aback by the sudden evolution of a greenish gas that he described as having “a suffocating smell which was most oppressive to the lungs.” Scheele didn’t know it at the time, but he had just produced chlorine, a gas that would change history. The reaction between pyrolusite and hydrochloric acid yields manganese chloride and chlorine gas!

Pyrolusite is a naturally occurring form of manganese dioxide, but where did Scheele get hydrochloric acid? For that discovery, we go back to the ninth century and the Arabian alchemist Jabir ibn Hayyan or “Geber,” as he is known in English. Geber produced hydrochloric acid by combining sodium chloride, common salt, with “oil of vitriol,” which we know today as sulfuric acid. And where would sulphuric acid have come from? When “green vitriol,” a naturally occurring form of the mineral ferrous sulphate heptahydrate, is heated, it releases sulphuric acid which can then be collected by distillation. The word vitriol comes from the Latin “vitriolum” for “glassy,” as crystals of the substance resemble pieces of coloured glass. Geber was obviously a pretty clever chap, but didn’t want to give away his secrets, and much of his work was documented in alchemical code. To the uninitiated this looked like “gibberish,” a term that derives from his name.

Now back to Scheele. Besides noting the gas he produced irritated his lungs, he also observed that it turned coloured flowers and green plants white, dissolved in water and was deadly to insects. However, he never realized that he had discovered a new element. It was only in 1811, that the brilliant English chemist Sir Humphry Davy came to that conclusion and named the gas chlorine, from the Greek “chloros,” meaning pale green.

While Scheele did not pursue his discovery any further, he did publish a report of his experiment. Some 10 years later, this came to the attention of French chemist Claude Louis Berthollet who recognized the value of chlorine in bleaching fabrics. Using a toxic gas, though, presented difficulties. Berthollet sought a solution and working in his lab in Javel, a village near Paris, he found one! Passing the gas into a solution of “washing soda” (sodium carbonate extracted from the ashes of burned seaweed) yielded a liquid that bleached cotton and removed stains from clothes at room temperature. The liquid was christened “eau de Javel,” after the village where it was discovered.

Today we know that when chlorine dissolves in water it forms sodium hypochlorite and hypochlorous acid, both of which are oxidizing agents, meaning that they can steal electrons from other molecules. Since electrons form the bonds that bind atoms in molecules, their theft results in the molecules falling apart. This is the fate of coloured molecules when they meet hypochlorite bleach. And not only coloured, but smelly molecules as well, a property that came to the attention of Hungarian physician Ignaz Semmelweis in 1846. He was concerned about the number of women who were dying in hospital after giving birth and noted that the death rate was greater among the women who were attended by physicians than midwives.

Semmelweis observed that the doctors often came to the obstetrics ward straight from the anatomy lab where they had been carrying out dissections, and hypothesized that they were contaminating their hands with smelly “cadaverous particles” that were possibly finding their way into women’s bodies. He was right. The doctors were infecting the women with germs! Semmelweis didn’t know anything about germs, but he suggested the doctors wash their hands with a hypochlorite solution to remove the smell. Soon, the death rate dropped dramatically, but despite the evidence, Semmelweis’s theory about hand washing made no sense to his contemporaries, and his ideas were rejected. Twenty years later, Louis Pasteur would vindicate Semmelweis by demonstrating that childbed fever was caused by a bacterium that was destroyed by bleach.

Pasteur’s formulation of the germ theory of disease also took a while to get a foothold, but by the 1890s suspicion was gathering that water contaminated with sewage carried germs and transmitted disease. The first attempts to disinfect water with bleach were made in 1893 in [Hamburg](https://en.wikipedia.org/wiki/Hamburg), Germany, and in 1897 [Maidstone](https://en.wikipedia.org/wiki/Maidstone) in England became the first town to have its entire water supply treated with chlorine. Within two decades, the disinfection of water supplies became widespread, and continues to this day, saving millions of lives.

However, chlorine can also take lives. This became strikingly evident when the Germans launched the first gas attack in 1915 at Ypres killing 5,000 Allied soldiers. More recently, evidence emerged that the Syrian government used chlorine on at least two occasions. Obviously, chlorine, like many other chemicals, is two faced, with potential for good or bad. But it doesn’t make a decision on how it is to be used. People make that decision.

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